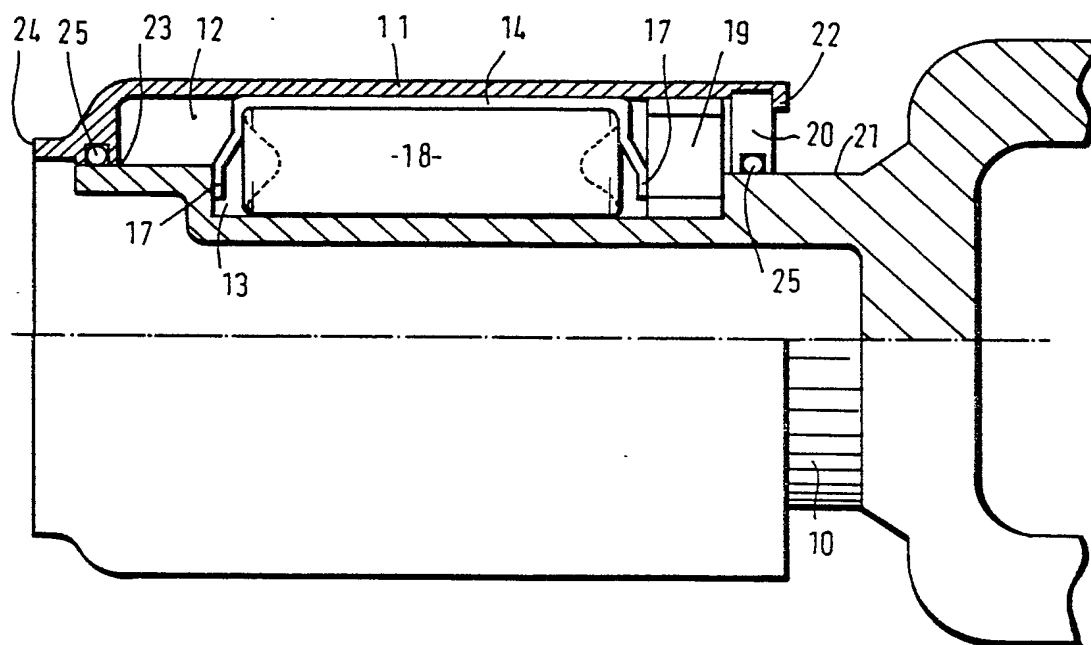




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification⁴ : F16D 3/06	A1.	(11) International Publication Number: WO 86/ 07120 (43) International Publication Date: 4 December 1986 (04.12.86)
(21) International Application Number: PCT/GB86/00280 (22) International Filing Date: 19 May 1986 (19.05.86) (31) Priority Application Number: 8513070 (32) Priority Date: 23 May 1985 (23.05.85) (33) Priority Country: GB (71) Applicant (for all designated States except US): BRD COMPANY LIMITED [GB/GB]; P.O. Box 2, Aldridge, Walsall, West Midlands, WS9 8DT (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : FISHER, Leslie, George [GB/GB]; 74 Cliveden Avenue, Perry Barr, Birmingham, B42 1SL (GB). (74) Agents: ROBERTSON, Bernard, C. et al.; Guest, Keen and Nettlefolds, plc, Group Patents & Licensing Department, P.O. Box 55, Ipsley House, Ipsley Church Lane,		Redditch, Worcestershire, B98 OTL (GB). (81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: SLIDING SPLINED JOINT**(57) Abstract**

A sliding splined joint comprising a shaft (10) and sleeve (11) and intermediate members (14) each engaging a groove in the sleeve and connected to the shaft by way of a resilient element (18) so that the joint is torsionally resilient.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT Austria	GA Gabon	MR Mauritania
AU Australia	GB United Kingdom	MW Malawi
BB Barbados	HU Hungary	NL Netherlands
BE Belgium	IT Italy	NO Norway
BG Bulgaria	JP Japan	RO Romania
BR Brazil	KP Democratic People's Republic of Korea	SD Sudan
CF Central African Republic	KR Republic of Korea	SE Sweden
CG Congo	LI Liechtenstein	SN Senegal
CH Switzerland	LK Sri Lanka	SU Soviet Union
CM Cameroon	LU Luxembourg	TD Chad
DE Germany, Federal Republic of	MC Monaco	TG Togo
DK Denmark	MG Madagascar	US United States of America
FI Finland	ML Mali	
FR France		

GMD/P85.008

SLIDING SPLINED JOINT

This invention relates to a sliding splined joint, comprising a sleeve and a shaft fitting within the sleeve, connected for torque transmission and relative axial movement therebetween.

5 Sliding splined joints are well known, and typically are used in drive shafts where the installation thereof requires that the shaft is capable of a change in length. Usually splined joints are torsionally rigid. It is also known that shaft joints can incorporate resilient
10 elements to provide a degree of torsional resilience, e.g. to attenuate shock torque loadings or torsional vibration. Such joints have not, however, been able to provide for relative axial movement as have conventional splined joints.

15 It is the object of the present invention to provide a joint which is torsionally resilient and yet provides for relative axial movement in the manner of a splined joint.

20 According to the present invention, we provide a sliding splined joint, comprising a sleeve and a shaft fitting within the sleeve, wherein at least one intermediate member is provided engaging for torque transmission with one of said shaft and sleeve and slidable axially thereof, and connected for torque
25 transmission with the other of said shaft and sleeve by at least one resilient element.

Preferably there is provided a plurality of said intermediate members, circumferentially spaced about said joint and each engaging one groove of said shaft or sleeve for sliding movement therealong, and each
5 connected to said sleeve or shaft, as the case may be, by way of a respective resilient element.

Each of said intermediate members may be of sheet metal, of elongate form defining an elongate recess facing a corresponding recess in the sleeve or shaft,
10 with an elongate element of resilient material received in said facing recesses. Intermediate members of such form may be economically manufactured, and readily available rods or bars of rubber or other suitable elastomer used as the resilient elements.

15 These and other features of the invention will now be described by way of example with reference to the accompanying drawings, of which:-

Figure 1 is an elevation, partly in section, of a splined joint according to the invention;

20 Figure 2 is an end view, again partly in section, of the joint.

The illustrated splined joint comprises a shaft 10 fitting within a sleeve 11. The sleeve is provided internally with a number of circumferentially spaced
25 axially extending grooves or recesses 12, resembling relatively large spline grooves, whose cross-sectional shape is shown in Figure 2. The shaft 10 is provided with circumferentially spaced elongate recesses 13 which face the grooves 12 and have a similar cross-sectional
30 shape as also clearly shown in Figure 2 of the drawings.

Each groove 12 receives an intermediate member 14 which is of sheet metal, of generally U-shaped cross-section having a base wall 15 which engages the base of groove 12 and side walls 16 engaging the side walls of the groove. At each end, the intermediate member 14 has a spring finger 17 extending radially inwardly of the joint and also axially thereof. A rod or bar like element 18 of resilient material, e.g. a suitable grade of rubber or other elastomer, is received between the intermediate member 14 and the recess 13, and is so dimensioned that when the joint is assembled it is under a degree of compression, so that the intermediate member 14 is held firmly in engagement with the groove 12, but is still able to move axially thereof. At an end of recess 13, a stop element 19 is received, whose cross-sectional shape is such that it seats within recess 13 but has a clearance from the side walls of groove 12, and will only make contact with one or other of the side walls of groove 12 after a predetermined amount of angular displacement has occurred between the shaft 10 and sleeve 11.

The end of sleeve 11 is closed by a two part annular support bearing 20, engaging surface 21 of shaft 10. It is held in place within the sleeve 11 by a rolled over lip 22 at the end of the sleeve. The shaft 10 at this end may be integral with or connected to a torque transmitting member such as the yoke of a Hookes universal joint illustrated. The other end of sleeve 11 engages, at 23, the surface of shaft 10, and has a spigot 24 for connection to a tubular shaft element, e.g. by friction welding.

In use of the joint, axial sliding is provided by movement of the intermediate members 14 along respective

grooves 12 in the sleeve 11. Torsional resilience is provided by the resilient elements 18 which establish the torque transmitting connection between the shaft 10 and the intermediate members 14. The fingers 17 centralise the intermediate members between the stop members 19 and the other ends of recesses 13, and small axial displacements in the joint may be taken by the resilience of elements 18, if there is any resistance to sliding of the intermediate members axially of the sleeve, caused by the force with which the intermediate members are urged into engagement with the walls of grooves 12 by the elements 18. Under excess torque, stop members 19 prevent damage to the resilient elements 18 by limiting the possible torsional displacement between the shaft and sleeve. Alignment between the shaft and sleeve is maintained by the support bearing 20 and the engagement between the shaft and sleeve at 23.

For lubrication, and possibly to assist damping, the assembly may be filled with a lubricant such as a suitable grease. To retain it in the joint, seals may be provided at 25. A suitable material must be used for the resilient elements 18, so as not to be degraded by such lubricant.

It will be appreciated that modifications may be made to the illustrated joint, in particular, the arrangement of the intermediate members engaging directly with the grooves in the sleeve, and the resilient elements being interposed between the intermediate members and the shaft, may be inverted, i.e. the intermediate members may engage grooves in the shaft and be resiliently supported relative to the sleeve.

CLAIMS

1. A sliding splined joint, comprising a sleeve (11) and a shaft (10) fitting within the sleeve (11), wherein at least one intermediate member (14) is provided engaging for torque transmission with one of said shaft (10) and sleeve (11) and slidable axially thereof, and connected for torque transmission with the other of said shaft (10) and sleeve (11) by at least one resilient element (18).
2. A joint according to Claim 1 further characterised in that said one of said shaft (10) and sleeve (11) is provided with circumferentially spaced axially extending grooves (12), and there is provided a plurality of said intermediate members (14), circumferentially spaced about said joint and each engaging one groove (12) for axial sliding movement therealong, and each connected to said sleeve (11) or shaft (10), as the case may be, by way of a respective resilient element (18).
3. A joint according to Claim 2 further characterised in that each of said intermediate members (14) is of sheet metal, of elongate form having walls (15, 16) defining an elongate recess facing a corresponding recess (13) in said sleeve (11) or shaft (10), with an element (18) of resilient material received in said facing recesses.
4. A joint according to Claim 3 further characterised in that each intermediate member (14) has formations (17) for centring the intermediate member axially relative to said recess (13).

5. A joint according to any one of the preceding claims further characterised in that there is provided stop means (19), operable to limit torsional displacement between said shaft (10) and sleeve (11).
- 5 6. A joint according to Claim 3, Claim 4, or Claim 5 further characterised in that each resilient element (18) comprises a rod like element of an elastomeric material.
7. A joint according to any one of the preceding claims further characterised by a support bearing (20) to
10 maintain alignment between said shaft (10) and sleeve (11).
8. A drive shaft incorporating a joint according to any one of the preceding claims.

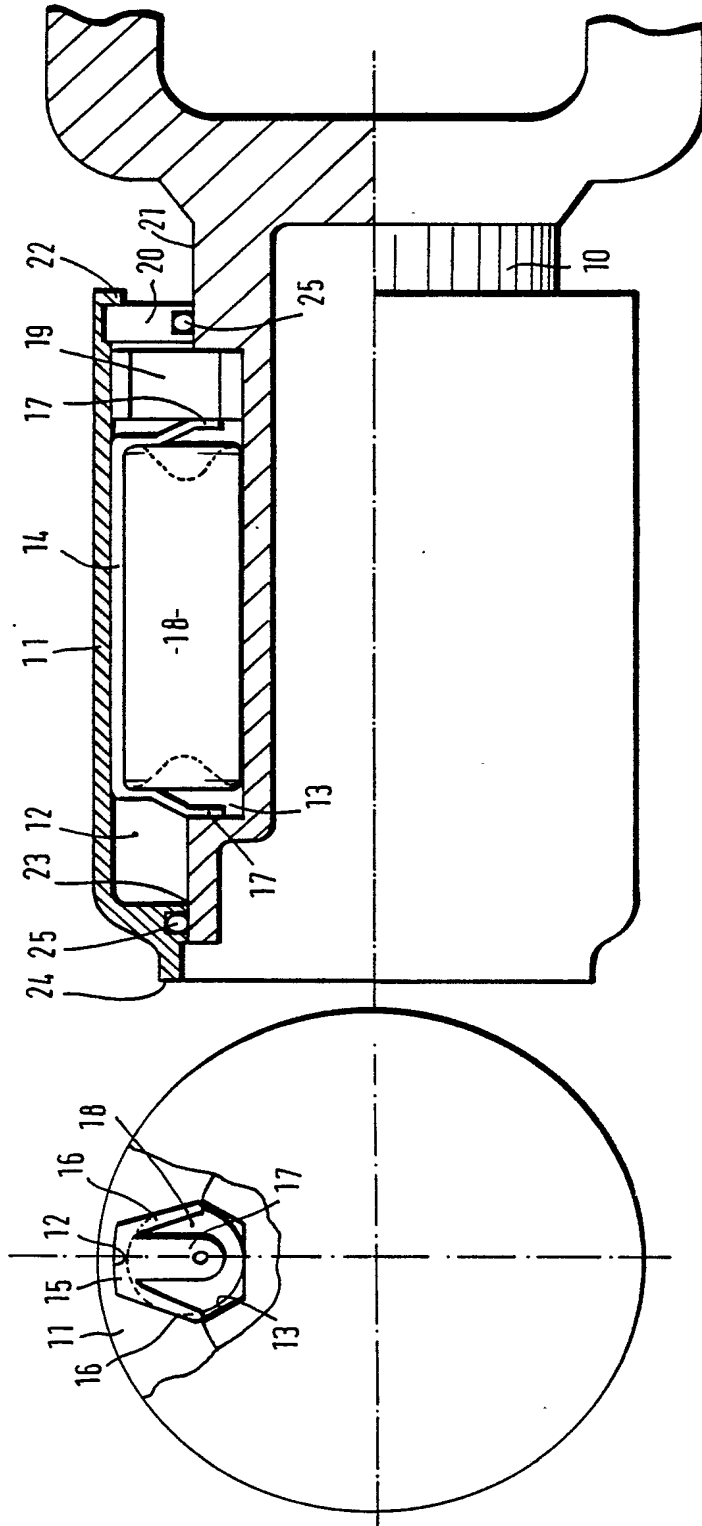


FIG. 1.

FIG. 2.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 86/00280

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : F 16 D 3/06																										
II. FIELDS SEARCHED <div style="text-align: center; margin-top: 10px;">Minimum Documentation Searched ⁷</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%;">Classification System</th> <th style="width: 75%;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;">IPC⁴</td> <td style="padding: 5px;">F 16 D; F 16 C</td> </tr> </table> <div style="text-align: center; margin-top: 10px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	IPC ⁴	F 16 D; F 16 C																				
Classification System	Classification Symbols																									
IPC ⁴	F 16 D; F 16 C																									
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category ⁹</th> <th style="width: 60%;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%;">Relevant to Claim No. ¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>FR, E, 74137 (SCHLOEMANN) 7 November 1960, see abstract; figures --</td> <td style="text-align: center; vertical-align: top;">1, 2, 3</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>FR, A, 1344257 (GENERAL TIRE) 21 October 1963, see page 3, right-hand column, last paragraph, lines 53-59, abstract 1,; figures --</td> <td style="text-align: center; vertical-align: top;">1, 8</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>--</td> <td style="text-align: center; vertical-align: top;">2, 3</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>GB, A, 1142976 (FERROPLAST) 12 February 1969, see page 2, lines 1-14; figures --</td> <td style="text-align: center; vertical-align: top;">1, 2, 6, 7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>CH, A, 329843 (NEIDHART) 30 June 1958, --</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>FR, A, 2018101 (SCHWARTZ) 29 May 1970 --</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>FR, A, 2431988 (ALSTHOM) 22 February 1980 -----</td> <td></td> </tr> </tbody> </table>			Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	FR, E, 74137 (SCHLOEMANN) 7 November 1960, see abstract; figures --	1, 2, 3	X	FR, A, 1344257 (GENERAL TIRE) 21 October 1963, see page 3, right-hand column, last paragraph, lines 53-59, abstract 1,; figures --	1, 8	A	--	2, 3	A	GB, A, 1142976 (FERROPLAST) 12 February 1969, see page 2, lines 1-14; figures --	1, 2, 6, 7	A	CH, A, 329843 (NEIDHART) 30 June 1958, --		A	FR, A, 2018101 (SCHWARTZ) 29 May 1970 --		A	FR, A, 2431988 (ALSTHOM) 22 February 1980 -----	
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³																								
X	FR, E, 74137 (SCHLOEMANN) 7 November 1960, see abstract; figures --	1, 2, 3																								
X	FR, A, 1344257 (GENERAL TIRE) 21 October 1963, see page 3, right-hand column, last paragraph, lines 53-59, abstract 1,; figures --	1, 8																								
A	--	2, 3																								
A	GB, A, 1142976 (FERROPLAST) 12 February 1969, see page 2, lines 1-14; figures --	1, 2, 6, 7																								
A	CH, A, 329843 (NEIDHART) 30 June 1958, --																									
A	FR, A, 2018101 (SCHWARTZ) 29 May 1970 --																									
A	FR, A, 2431988 (ALSTHOM) 22 February 1980 -----																									
<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>¹⁰ * Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>																										
IV. CERTIFICATION <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">19th August 1986</div> </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">22 SEP 1986</div> </td> </tr> <tr> <td style="width: 50%; padding: 5px;"> International Searching Authority <div style="text-align: center; margin-top: 10px;">EUROPEAN PATENT OFFICE</div> </td> <td style="width: 50%; padding: 5px;"> Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> L. ROSSI </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">19th August 1986</div>	Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">22 SEP 1986</div>	International Searching Authority <div style="text-align: center; margin-top: 10px;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> L. ROSSI </div>																				
Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">19th August 1986</div>	Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">22 SEP 1986</div>																									
International Searching Authority <div style="text-align: center; margin-top: 10px;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> L. ROSSI </div>																									

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO.

PCT/GB 86/00280 (SA 13331)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 04/09/86

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-E- 74137		None	
FR-A- 1344257		None	
GB-A- 1142976		None	
CH-A- 329843		IT-A- 498925 DE-A- 936835 BE-A- 515037 US-A- 2729442 FR-A- 1064117 GB-A- 710244 NL-C- 87600 CH-A- 295766 AU-B- 157435 AT-A- 178766 CA-A- 521190 IE-A- 20236 NO-A- 84046 SE-A- 153055 IT-A- 528148 FR-A- 1117193 GB-A- 730534 AU-B- 163944 AT-A- 186071 IE-A- 20879	
FR-A- 2018101	29/05/70	GB-A- 1216439 DE-A- 1910126 BE-A- 737688	23/12/70 10/09/70 02/02/70
FR-A- 2431988	22/02/80	None	

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82